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ABSTRACT

Data from the Academic Research and Development (R&D) Survey and other surveys were used to analyze patterns of R&D activity in the United States. For the purpose of this analysis, the most recent data update from the report "National Patterns of R&D Resources" adjusts university and college R&D performance to net out R&D expenditures reported as passed through to educational sub-recipients beginning with 1998. Data were obtained from 609 universities and colleges that grant graduate degrees in the sciences or engineering and expend at least $150,000 in research in the surveyed fiscal year. (Author/SOE)

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ACADEMIC R&D SPENDING MAINTAINS GROWTH FROM ALL MAJOR SOURCES IN FY 2001

by M. Marge Machen and Brandon Shackelford

Separately budgeted research and development (R&D)[1] expenditures at universities and colleges continued their upward growth in FY 2001, reaching $32.7 billion—a total increase of 9 percent over FY 2000 levels. When adjusted for inflation, academic R&D increased 6 percent in FY 2001, compared with the 4.3 percent constant dollar average annual growth that was reported during the previous 10 years. These statistics are derived from the National Science Foundation's (NSF) Survey of Research and Development Expenditures at Universities and Colleges (Academic R&D Survey) and are for science and engineering R&D activities only.

Federally financed academic R&D spending increased 10 percent (7 percent in constant dollars) in FY 2001 to $19.2 billion. Federal funding provided 59 percent of the R&D dollars expended at universities and colleges (table 1). Increases in R&D expenditures from all non-Federal sources combined increased by $1 billion—8 percent—reaching $13.5 billion in FY 2001. Funds from institutions' own sources increased the fastest, over 10 percent in FY 2001. Funds from all other nongovernment/nonindustry sources (including private foundations and voluntary sources) rose 8 percent. State and local governments' funds were up 5 percent in FY 2001, and industry funding was up 4 percent.

[1]Separately budgeted research and development (R&D) includes all funds expended for activities specifically organized to produce research and development outcomes and commissioned by an agency either external to the institution or separately budgeted by an organizational unit within the institution.

Total expenditures devoted to basic research[2] at universities and colleges rose to $24.2 billion, an 8 percent increase over FY 2000, or a 6 percent gain after adjusting for inflation (table 1).

Revised methodology provides for improved estimates of basic research and passed-through funds.

Estimation of Basic Research

A recent review of responses to the Academic R&D Survey's items requesting the percentage of total and Federal R&D funds that are basic research determined that the aggregate statistics could be improved by refining the imputation methodology for nonresponse to this item.[3] NSF has reestimated academic basic research statistics for FY 1998 and forward. See table 2 for a summary of the changes that the revised imputation methodology makes in the aggregate basic research totals, a 5–6 percentage point increase in the basic research share.

In the past, if a respondent did not reply to the basic research items, the prior year's basic research share

[2]Basic research is defined on the survey as research "directed toward an increase of knowledge; it is research where the primary aim of the investigator is a fuller knowledge or understanding of the subject under study rather than a specific application thereof."

[3]The University of California was instrumental in assisting NSF in providing more accurate basic research data.

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TABLE 1. R&D expenditures at universities and colleges: FY 1999-2001

Item	1999	2000	2001	1999	2000	2001
	Millions of current dollars			Millions of constant 1996 dollars[1]		
Total	27,505	30,042	32,723	26,235	28,113	29,892
Source of funds						
Federal Government	16,071	17,508	19,191	15,329	16,384	17,531
State and local governments	2,019	2,196	2,315	1,926	2,055	2,115
Industry	2,028	2,152	2,234	1,934	2,014	2,041
Institutional funds	5,395	5,933	6,553	5,146	5,552	5,986
All other sources	1,992	2,253	2,430	1,900	2,108	2,220
Character of work						
Basic research	20,332	22,416	24,243	19,393	20,977	22,145
Applied research and development	7,173	7,626	8,481	6,842	7,136	7,747

[1] Based on the gross domestic product implicit price deflator.

NOTE: Because of rounding, figures may not add to the total shown.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, Fiscal Year 2001.

(whether reported by or imputed for the respondent) was carried forward. Interviews with respondents revealed that in some cases abnormal or erroneous values (such as zero percent basic research) were imputed forward for several years. The revised imputation methodology carries forward the prior year's basic research share only if that year's data were reported or estimated by the respondent. In all other cases an econometric model is now used to impute the amount of total and Federal basic research for the respondent. The model employed takes into account differences between public and private institutions and non-Federal sources of R&D funding.

Top Research Performers

R&D expenditures remain highly concentrated in relatively few institutions. The 100 leading research institutions accounted for 82 percent of federally financed R&D spending and 80 percent of all R&D dollars in FY 2001. The 20 leading research performers represented a 32 percent share of federally sponsored expenditures and 31 percent of total academic R&D spending.

Most of the universities that ranked in the top 20 in FY 2001 also ranked among the leading 20 academic performers in FY 2000. Several changed rank positions, but only Baylor College of Medicine was new to this group in FY 2001 and replaced Duke University (ranked 20th in FY 2000) (table 3).

Passed-Through Funds

In an attempt to capture all academic R&D expenditures, the NSF Academic R&D Survey instructs respondents to "include research funds for which an outside organization, educational or other, is a subrecipient." The amount of R&D funds passed through to subrecipients has grown from at least 3.8 percent of total academic R&D ($1.0 billion) in FY 1998 to at least 5.0 percent of total academic R&D ($1.6 billion) in FY 2001.[4] Table 4 illustrates that a higher percentage of federally funded R&D dollars are passed through to subrecipients than non-Federal sources of funds. In FY 2001, 7.2 percent of all federally funded academic R&D was passed through to subrecipients as contrasted to 1.8 percent of all non-Federal sources of funds. It is unclear whether this difference is the result of Federal sources of funding explicitly encouraging cross-institution R&D collaboration.

In addition to reporting R&D funds passed through to all subrecipients, respondents also differentiate funds passed through to educational subrecipients and other subrecipients. Given the coverage of the Academic R&D Survey and the specific wording of its instructions, it is

[4]The response rate for this item was 89.4 percent in FY 1998, 87.5 percent in FY 1999, 89.2 percent in FY 2000, and 89.5 percent in FY 2001. Values for this item are not imputed for nonrespondents so reported totals are possibly underestimates of true totals. In addition, some respondents reporting total and Federal funds passed through did not break out these funds by type of subrecipient (educational or other).

TABLE 2. Academic basic research, before and after corrections and revised imputation methodology: FY 1997-2000

Type of expenditure	R&D and basic research expenditures				Basic research expenditures as percentage of corresponding R&D total			
	1997	1998	1999	2000	1997	1998	1999	2000
	Millions of dollars				Percent			
Total R&D	24,363	25,848	27,505	30,042	–	–	–	–
Federal R&D	14,309	15,145	16,071	17,508	–	–	–	–
Non-Federal R&D	10,054	10,703	11,434	12,534	–	–	–	–
Before corrections and revisions[1]								
Total basic research	16,593	17,445	18,931	20,791	68.1	67.5	68.8	69.2
Federal basic research	10,310	10,915	11,865	12,930	72.1	72.1	73.8	73.9
Non-Federal basic research	6,283	6,530	7,066	7,861	62.5	61.0	61.8	62.7
After corrections and revisions[2]								
Total basic research	–	19,061	20,332	22,416	–	73.7	73.9	74.6
Federal basic research	–	11,844	12,630	13,808	–	78.2	78.6	78.9
Non-Federal basic research	–	7,217	7,702	8,608	–	67.4	67.4	68.7

– = Not applicable.

[1] Data in this category reflect basic research totals as reported in the Survey of Research and Development Expenditures at Universities and Colleges, Fiscal Year 2000 report.

[2] Differences between data in this category and data in the previous category are the result of both respondent corrections to prior-reported data as well as the implementation of a revised imputation methodology for the basic research items.

SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, Fiscal Year 2001.

reasonable to believe that virtually all of the R&D expenditures that were reported as being passed to educational subrecipients were captured by the survey twice—from the originating institutions and from the subrecipient institutions. Although it is more difficult for respondents to identify funds they received as subrecipients, data collected by NSF related to this question confirm this hypothesis.[5]

Data Notes

The academic R&D expenditures data presented in this InfoBrief were obtained from 609 universities and colleges that grant graduate degrees in the sciences or engineering and expend at least $150 thousand in research in the surveyed fiscal year. NSF has collected annual data through this survey since 1972. The FY 2001 Survey of Research and Development Expenditures at Universities and Colleges detailed statistical tables are available on the Web at http://www.nsf.gov/sbe/srs/nsf03316/start.htm.

[5] Data from the Academic R&D Survey and other surveys are used to analyze patterns of R&D activity in the United States. For the purpose of this analysis the most recent data update of the report *National Patterns of R&D Resources* adjusts university and college R&D performance to net out R&D expenditures reported as passed through to educational subrecipients beginning with FY 1998. *National Patterns* reports and data updates can be accessed on the NSF website: http://www.nsf.gov/sbe/srs/nprdr/start.htm.

NSF makes available profiles for individual doctorate-granting institutions and institutions of higher education with science and engineering (S&E) departments that grant master's degrees (*Academic Institutional Profiles*, http://www.nsf.gov/sbe/srs/profiles/toc.htm). The profiles contain data from this survey as well as from two other NSF academic S&E surveys: the Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions and the Survey of Graduate Students and Postdoctorates in Science and Engineering. Current and historic data from the three surveys are also available via the World Wide Web (http://www.nsf.gov/sbe/srs/) by individual survey and the Computer-Aided Science Policy Analysis and Research (WebCASPAR) database system, a Web tool for retrieval and analysis of statistical data on academic science and engineering resources (http://caspar.nsf.gov).

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TABLE 3. Twenty institutions reporting the largest FY 2001 academic R&D expenditures in the sciences and engineering: FY 2000-01
(Millions of dollars)

Institution	Total		Federal	
	2000	2001	2000	2001
Total [1]	30,042	32,723	17,508	19,191
Total, leading 20 institutions	9,403	10,176	5,619	6,125
1. Johns Hopkins U. [2]	901	999	793	880
2. U. CA Los Angeles	531	694	274	313
3. U. WI Madison	554	604	279	304
4. U. Michigan	552	601	364	396
5. U. Washington	529	590	390	435
6. U. CA San Diego	519	557	326	343
7. U. CA San Francisco	443	525	249	277
8. Stanford U.	558	483	367	384
9. U. Pennsylvania	430	470	312	352
10. U. Minnesota	411	462	230	264
11. Pennsylvania State U.	428	458	226	246
12. U. CA Berkeley	519	446	208	208
13. Cornell U.	410	444	230	240
14. MA Institute of Technology	426	435	307	304
15. U. CA Davis	365	432	142	155
16. Texas A&M U.	397	470	150	149
17. Washington U.	362	407	254	285
18. U. IL Urbana-Champaign	373	391	193	195
19. Ohio State U.	361	391	132	161
20. Baylor C. of Medicine	334	381	193	234
Total, all other institutions	20,639	22,547	11,889	13,066

[1] Data do not include R&D performed by university-administered federally funded research and development centers.

[2] Includes R&D expenditures for Applied Physics Laboratory (APL). For FY 2001, APL reported $482 million in total and $463 million in federally financed R&D expenditures.

NOTE: Because of rounding, detail may not add to totals.

SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, Fiscal Year 2001.

TABLE 4. Academic research and development funds passed through to subrecipients: FY 1998-2001

Source of funds	R&D expenditures				Passed through expenditures as a percentage of corresponding R&D total			
	1998	1999	2000	2001	1998	1999	2000	2001
	Millions of dollars				Percent			
Total R&D	25,848	27,505	30,042	32,723	–	–	–	–
Federal R&D	15,145	16,071	17,508	19,191	–	–	–	–
Non-Federal R&D	10,703	11,434	12,534	13,532	–	–	–	–
Funds passed through to all subrecipients								
Total R&D	994	1,253	1,426	1,627	3.8	4.6	4.7	5.0
Federal R&D	846	1,027	1,205	1,380	5.6	6.4	6.9	7.2
Non-Federal R&D	148	226	221	247	1.4	2.0	1.8	1.8
Funds passed through to educational subrecipients								
Total R&D	479	572	705	793	1.9	2.1	2.3	2.4
Federal R&D	421	502	630	707	2.8	3.1	3.6	3.7
Non-Federal R&D	58	70	74	86	0.5	0.6	0.6	0.6

– = Not applicable

NOTE: The data presented on passed through funds are lower bound estimates because values were not imputed for nonrespondents. In addition, some respondents reporting total and Federal funds passed through did not break out these funds by type of subrecipient (educational or other).

SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, Fiscal Year 2001.

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